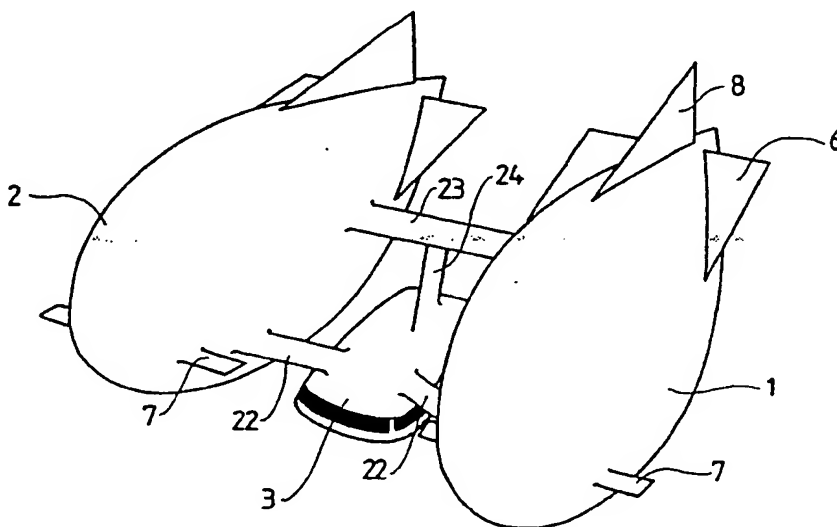




## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<b>(51) International Patent Classification<sup>4</sup> :</b>  <b>B64B 1/06</b>	<b>A1</b>	<b>(11) International Publication Number:</b> <b>WO 89/10868</b>  <b>(43) International Publication Date:</b> 16 November 1989 (16.11.89)
<b>(21) International Application Number:</b> PCT/AU88/00440 <b>(22) International Filing Date:</b> 15 November 1988 (15.11.88) <b>(30) Priority data:</b> PI 8252                      13 May 1988 (13.05.88)                      AU <b>(71) Applicant (for all designated States except US):</b> MARCRO HOLDINGS PTY. LTD. [AU/AU]; 24 Christowel Street, Camberwell, VIC 3124 (AU). <b>(72) Inventor; and</b> <b>(75) Inventor/Applicant (for US only) :</b> BEGGS, Cromwell, Semple [AU/AU]; 24 Christowel Street, Camberwell, VIC 3124 (AU). <b>(74) Agents:</b> SANDERCOCK, Charles et al.; Davies & Collison, 1 Little Collins Street, Melbourne, VIC 3000 (AU).		<b>(81) Designated States:</b> AT, AT (European patent), AU, BB, BE (European patent), BG, BJ (OAPI patent), BR, CF (OAPI patent), CG (OAPI patent), CH, CH (European patent), CM (OAPI patent), DE, DE (European patent), DK, FI, FR (European patent), GA (OAPI patent), GB, GB (European patent), HU, IT (European patent), JP, KP, KR, LK, LU, LU (European patent), MC, MG, ML (OAPI patent), MR (OAPI patent), MW, NL, NL (European patent), NO, RO, SD, SE, SE (European patent), SN (OAPI patent), SU, TD (OAPI patent), TG (OAPI patent), US.  <b>Published</b> <i>With international search report.</i>

**(54) Title:** IMPROVED AIRSHIP**(57) Abstract**

An airship comprises two substantially parallel, spaced apart and semirigid hulls (1, 2) adapted to contain a lifting gas, a gondola (3) is connected to the hulls (1, 2), and a drive means is provided to impart vertical lift to the airship. A drive means adapted to impart horizontal motion to the airship may also be provided. Each hull (1, 2) includes a framework comprising two semirigid circumferential bands which are interconnected by a plurality of longitudinal strips and a plurality of radially extending spokes. Support means (22, 23, 24) interconnect the circumferential bands of each hull (1, 2) to the gondola (3). Each hull (1, 2) consists of an outer covering enclosing a number of gas containing cells. The hulls (1, 2) are longer than their width and wider than their height and in cross-sections they have a shape approximate to that of an aerofoil. Ventrally as compared to dorsally the hulls (1, 2) are substantially flatter. Vertical fins (8), tail planes (6), forward stabilizers (7) are provided to assist in the overall manoeuvrability and stability of the airship.

***FOR THE PURPOSES OF INFORMATION ONLY***

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	FI	Finland	ML	Mali
AU	Australia	FR	France	MR	Mauritania
BB	Barbados	GA	Gabon	MW	Malawi
BE	Belgium	GB	United Kingdom	NL	Netherlands
BF	Burkina Faso	HU	Hungary	NO	Norway
BG	Bulgaria	IT	Italy	RO	Romania
BJ	Benin	JP	Japan	SD	Sudan
BR	Brazil	KP	Democratic People's Republic of Korea	SE	Sweden
CF	Central African Republic	KR	Republic of Korea	SN	Senegal
CG	Congo	LI	Liechtenstein	SU	Soviet Union
CH	Switzerland	LK	Sri Lanka	TD	Chad
CM	Cameroon	LU	Luxembourg	TG	Togo
DE	Germany, Federal Republic of	MC	Monaco	US	United States of America
DK	Denmark	MG	Madagascar		
ES	Spain				

- 1 -

1

3

5

7

9

11

13

15

## IMPROVED AIRSHIP

17       The present invention relates to improvements in  
air-ships, being load-carrying means which derive their  
19 lifting power from aerostatic forces rather than the  
aerodynamic forces such as those that support a  
21 conventional aeroplane (fixed-wing craft). With such  
air-ships the lift is one of buoyancy, being derived from  
23 the differences which exist between the density of the  
atmosphere and that of a lifting gas contained by the  
25 air-ship itself.

27       With prior art arrangements the size of an air-ship  
is primarily, if not exclusively, determined by the actual  
29 volume of lifting gas required to lift the relevant  
payload (weight of the ship and its associated load, be it  
31 personnel and/or equipment). Air-ships have in the past  
been equipped with a propulsive means for controlling the  
33 attitude, speed, altitude and course and this in marked

- 2 -

1 contrast with what might be termed a free balloon, for  
2 which only altitude is effectively controllable, with  
3 velocity and direction of movement being dependent largely  
4 upon the vagaries of the wind/elements. The requirements  
5 of navigability and aerodynamic efficiency have caused an  
6 effective aerodynamic shape to be given to an air-ship,  
7 this shape being circular in cross-section, with a rounded  
8 nose and a tapering tail. With the known arrangements  
9 propulsion has been obtained from air propellers driven  
10 by, for example, internal combustion engines which are  
11 either mounted in nacelles attached to a hull or to a  
12 gondola or which are located within the hull and which  
13 drive propellers by means of shafts and gearing extending  
14 through a skin of the hull itself.

15  
16 The prior art arrangements have suffered from a  
17 number of disadvantages, in terms of their efficiency and  
18 effectiveness of operation. By way of example, the prior  
19 art arrangements have been found to necessitate an  
20 inordinately large hull size for any reasonable payload.  
21 Furthermore experience has shown that known or  
22 conventional types of air-ship suffer in terms of their  
23 controllability, manoeuvrability, stability etc. Indeed  
24 air-ships of the type currently now being re-introduced  
25 into service require constant trimming, etc. by the crew  
26 in order to maintain any sort of acceptable attitude, an  
27 on-going exercise which is extremely wearing on the crew.  
28 Furthermore such air-ships need a substantial number of  
29 crew for purposes of landing, take-off etc.

30  
31 The present invention seeks to at least partly  
32 overcome one or more of the problems and disadvantages  
33 associated with prior art air-ships and to provide a form  
of air-ship which is readily controllable and

- 3 -

1 manoeuvrable, capable of transporting substantial loads  
(personnel and/or plant) if required, eminently suitable  
3 for a variety of applications and is in fact effectively  
stable and controllable in most weather conditions.

5

The present invention provides an airship comprising  
7 two substantially parallel and spaced apart hulls adapted  
to contain a lifting gas, a gondola connected to the hulls  
9 and a drive means adapted to impart vertical lift to the  
air-ship.

11

Preferably there are two such drive means laterally  
13 spaced from one another with respect to the gondola.

15 Preferably there is a drive means adapted to impart  
horizontal motion to the air-ship.

17

Preferably the hulls are longer than they are wide  
19 and in longitudinal cross-section have a shape approximat-  
ing to an aerofoil whereby in use to provide vertical lift  
21 during forward motion in consequence of that aerofoil  
shape.

23

Preferably the hulls are wider than they are high.

25

Preferably ventrally as compared to dorsally the  
27 hulls are substantially flatter.

29 Preferably each hull is provided with an upwardly  
extending generally vertical stabilizer fin adjacent a  
31 rear end thereof.

33 Preferably said generally vertical stabilizer fin or  
part thereof is variable in attitude.

35

- 4 -

1 Preferably each hull is provided with a laterally  
extending generally horizontal stabilizer fin adjacent a  
3 rear part thereof.

5 Preferably said generally horizontal stabilizer fin  
or part thereof is variable in attitude.

7  
Preferably each hull is provided with a laterally  
9 extending generally horizontal stabilizer fin adjacent a  
forward end thereof.

11  
Preferably said generally horizontal stabilizer fin  
13 adjacent a forward end is variable in attitude.

15 Preferably the gondola is provided with landing  
wheels.

17  
Preferably each hull comprises an outer covering  
19 enclosing a number of gas containing cells.

21 Preferably the covering additionally encloses a  
number of normally empty cells into which gas may be  
23 passed from said gas containing cells to thereby relieve  
pressure in said gas containing cells.

25  
Preferably there is pressure responsive valve means  
27 adapted to open under a predetermined pressure to allow  
gas to pass from said gas containing cells to said  
29 normally empty cells.

31 Preferably there is pump means for pumping gas from  
said normally empty cells to said gas containing cells.

33

- 5 -

1 Preferably there is a framework comprising  
circumferential bands extending around the hulls, spacer  
3 members extending between said bands and spacing the hulls  
apart and suspension members extending from one of the  
5 spacer members and said bands and suspending the gondola.

7 In one instance the framework additionally comprises  
a generally centrally extending keel within each hull and  
9 connector members extending from said keel to said bands.

11 Preferably there is a plurality of generally  
radially extending members extending from said keel and  
13 supporting longitudinally extending stringer members.

15 In another instance the framework additionally  
comprises a plurality of generally radially extending  
17 members supporting longitudinally extending stringer  
members.

19

Preferably the radially extending members support  
21 circumferential members.

23 In order that the invention may be more clearly  
understood and put into practical effect reference will  
25 now be made to a preferred embodiment of an air-ship in  
accordance with the invention. The ensuing description is  
27 given by way of non-limiting example only and is with  
reference to the accompanying drawings, wherein:

29

FIG. 1 is a perspective view from above of a  
31 preferred embodiment of an air-ship in accordance with the  
invention;

33 FIG. 2 is a perspective view from below of the  
embodiment of FIG. 1;

- 6 -

1        FIG. 3 is a perspective view of a gondola for an  
air-ship in accordance with the invention;

3        FIGS. 4A and 4B are views of alternative embodiments  
of gondola;

5        FIG. 5 is a side elevational view of a hull for use  
in a preferred embodiment of an air-ship in accordance  
7 with the present invention;

9        FIG. 6 is another side elevational view of a most  
preferred hull showing certain constructional features;

11       FIG. 7 is a longitudinal cross-sectional view of the  
hull of FIG. 6;

13       FIG. 8 is a lateral cross-sectional view of the hull  
of FIG. 6; and

15       FIG. 9 depicts cross-sections at various stations  
marked on Figures 6 and 7.

17       As illustrated an air-ship in accordance with the  
present invention includes two separate and interconnected  
19 hulls 1 and 2, this in marked contrast to known air-ships,  
which employ or use one hull and one hull only.  
21 Experimentation has shown that it is this single hull  
concept which in itself contributes to the lack of  
23 stability exhibited by known air-ships. The twin-hull  
arrangement as now envisaged by the present applicant is  
25 responsible for a remarkable improvement in stability,  
controllability and manoeuvrability of the relevant  
27 air-ship. More particularly the twin-hull arrangement as  
now proposed affords predictable controllability,  
29 seemingly by reason of improved air flow around the twin  
hulls. In a practical sense the twin-hull arrangement can  
31 also be said to provide improved lift capability.

33       In one preferred arrangement each hull 1, 2 is  
constructed from kevlar (trade mark) and 6-layer



- 7 -

1 co-extruded plastics material laminate. The arrangement  
in accordance with the present invention preferably  
3 employs semi-rigid hulls, in other words hulls wherein the  
shape of each hull 1, 2 is to a certain extent maintained  
5 by gas pressure but where there is also provided a  
structural keel extending longitudinally from the nose to  
7 the tail, with perhaps additional structural reinforcement  
at the nose and at the attachment of the control  
9 surfaces. The frame-work may be constructed, preferably,  
of a number of girders running longitudinally of each hull  
11 connected by parallel-disposed substantially  
circumferential rings. The circumferential rings should  
13 preferably be substantially rigid. In an alternative  
embodiment, however, diametric braces may be employed in  
15 order to ensure a self-sustaining shape for each hull.

17       The respective hulls can be interconnected in any  
convenient manner and in turn are connected, again in any  
19 convenient manner, to a gondola 3. In the preferred  
embodiments illustrated the gondola 3, affixed or  
21 connected to the twin hulls 1, 2 in any suitable manner,  
in itself will be of an appropriate aerodynamic shape  
23 whereby if not so much to assist, at least not to inhibit,  
lift of the overall structure. Furthermore, the gondola  
25 can be so designed as to have viewing ports at both front  
and rear, not to mention along the sides, whereby to  
27 provide effectively 360° comprehensive viewing, this in  
marked contrast to gondolas in use on existing air-ships  
29 of conventional design. The gondola 3 can be of a  
suitable size to suit the intended usage for the  
31 air-ship. By way of example, a large-scale gondola 3  
could be employed if the air-ship is to be used for  
33 ferrying or carting substantial numbers of personnel or  
quantities of plant and the like equipment.

- 8 -

1 Alternatively, if the air-ship is to be used for purposes  
2 of tracking or surveillance, then smaller sized hulls 1, 2  
3 and gondola 3 could be employed.

5 In accordance with known practices the air-ship in  
6 accordance with the present invention will include means  
7 allowing for forward or rearward propulsive movement or  
8 drive. In the embodiments illustrated such means could  
9 take the form of at least one, and preferably two, engines  
10 4 preferably of the internal combustion type appropriately  
11 located and housed on or within the gondola 3 itself. In  
12 an especially preferred embodiment two Porsche high-speed  
13 by-pass engines can be employed for purposes of providing  
14 propulsion efficiency. Such engines, in conjunction with  
15 the asymmetric design of the hulls themselves, can be  
16 responsible for markedly improved efficiency of forward  
17 and rearward movement as desired.

19 Preferably the arrangement in accordance with the  
20 present invention will have means allowing for vertically  
21 upward or downward movement as conditions require. In the  
22 arrangements illustrated such a result can be achieved by  
23 the provision of one or more vertical lift engines 5  
24 appropriately disposed on the gondola 3, again  
25 appropriately housed, in any convenient manner, on or  
26 within the gondola 3 itself. Such vertical lift engines 5  
27 afford a substantial improvement over known air-ships,  
28 wherein lift was dependent solely upon the size of the  
29 hulls and the nature of the gas retained therein. In this  
30 regard it should be realized that there can sometimes be  
31 expected to occur situations wherein rapid vertically  
32 upward or downward movement is required, and the provision  
33 of the vertical lift engines 5 is responsible for such a  
34 capability in the present applicant's arrangement. By way

- 9 -

1 of example, if the air-ship is being used for purposes of  
surveillance in or over a combat zone, it may sometimes be  
3 extremely desirable to quickly gain altitude, whereby to  
lift the air-ship out of range of stray bullets, shells or  
5 other armament. Alternatively, when an air-ship in accord-  
ance with the invention is being used in a rescue  
7 situation, it may be desirable to lose altitude quickly -  
as for example to pick up injured personnel - and then to  
9 gain altitude with a view to safe travel.

11 The arrangement in accordance with the present  
invention furthermore preferably includes vertical fins 8  
13 and tail planes 6 intended to assist in overall manoeuvra-  
bility and stability. There are also provided forward  
15 stabilizers, generally designated 7, intended to assist in  
controlling the attitude of the craft even in high winds.  
17 Indeed the provision of such stabilizers 7 will afford the  
craft the capability of being able to turn in effectively  
19 its own width and to perform non-banked turns.

21 Retractable landing gear 9 may be provided.

23 The arrangement in accordance with the present  
invention will be responsible for a number of significant  
25 advantages when compared with prior art dirigibles or  
air-ships, as set out hereinafter in more detail.

27

Principally the arrangement in accordance with the  
29 present invention is responsible for a remarkably stable  
air-ship, and more importantly an air-ship which exhibits  
31 a remarkable degree of controllability and  
manoeuvrability, thereby lending itself to usage in a  
33 variety of circumstances, civil, commercial and even  
military. Secondly, and by reason of the overall shape of

- 10 -

1 the hulls and the gondola the operating costs in terms of  
both fuel and maintenance could be expected to be rather  
3 low, being as little as 15% of the cost of most existing  
conventional fixed-wing aircraft or helicopters. By its  
5 very nature the air-ship in accordance with the present  
invention would also be significantly quieter in its  
7 operation when compared to such fixed-wing aircraft or  
helicopters.

9

In perhaps a more practical sense an air-ship in  
11 accordance with the present invention would be capable of  
remaining airborne for a substantial period of time.  
13 Indeed the factors governing the duration of any flight  
would be the need for replenishing food, water and fuel  
15 supplies.

17 The air-ship in accordance with the present  
invention lends itself to usage in a variety of contexts  
19 and situations, for example as a mere personnel or freight  
carrier, for purposes of surveillance and rescue (over  
21 land or sea and by day or night), for military purposes  
(when appropriately armed), for tracking purposes, for  
23 patrolling State borders or territorial waters and  
coast-lines.

25

Reference is now made to FIGS. 6-9 which show in  
27 some detail some particularly preferred aspects of a  
preferred hull 19.

29

As shown in FIGS. 6-9, the hull 19 comprises two  
31 semi-rigid circumferential bands 20 and 21.

33 The band 20 is connected to the gondola 3 by a  
support member 22 and the gondola is further connected by  
35 another such support member to another such hull (not  
shown).

37

- 11 -

1        The band 21 is connected to that other such hull by  
a connector member 23 and that connector member is  
3 connected to the gondola 3 by a support member 24.

5        Extending between <sup>transverse</sup> the bands 20 and 21 and to the  
nose 26 and tail 27 of the hull is a plurality of  
7 longitudinal stringers 28. The stringers are supported  
intermediate the bands 20 and 21 and adjacent the nose 26  
9 and tail 27 by a plurality of generally radially extending  
spokes 29 which are adjusted in length to give the shape  
11 desired.

13       The shape of the hull 19 is to be noted and can be  
best conceived from the sections shown in FIG. 9.

15

In general, the hull 19 is broader in cross-section  
17 than it is high, is relatively flat in the ventral region  
31 as compared to the dorsal region 32 and in longitudinal  
19 cross-section as shown in FIG. 7 has the general form of  
an aerofoil.

21

Thus, it is believed that the shape of the hull will  
23 have a material effect on the overall stability of the  
air-ship with respect to roll and pitch and the general  
25 aerofoil shape should generate lift which may be of  
material assistance in certain adverse conditions or in  
27 times of emergency.

29       Within the hull 19 are primary gas cells 43-48 which  
will contain lifting gas and slave cells 41, 42, 49 and 50.  
31

The slave cells are connected to the primary cells  
33 by pressure responsive valves 52 which may be used to  
reduce any excess pressure in the primary cells as the

- 12 -

1 air-ship rises by passing gas to the slave cells which, at  
2 sea level, will be normally empty. Pump means may be  
3 provided for pumping gas from the slave cells to the  
4 primary cells.

5

6 The described arrangement has been advanced merely  
7 by way of explanation and many modifications may be made  
8 thereto without departing from the spirit and scope of the  
9 invention which includes every novel feature and  
10 combination of novel features herein disclosed.

11

- 13 -

## CLAIMS:-

1. An air-ship comprising two substantially parallel and spaced apart hulls adapted to contain a lifting gas, a gondola connected to the hulls and a drive means adapted to impart vertical lift to the air-ship.
2. An air-ship as claimed in claim 1, wherein there are two such drive means laterally spaced from one another with respect to the gondola.
3. An air-ship as claimed in claim 1 or claim 2, and including a drive means adapted to impart horizontal motion to the air-ship.
4. An air-ship as claimed in any preceding claim, wherein the hulls are longer than they are wide and in longitudinal cross-section have a shape approximating to an aerofoil whereby in use to provide vertical lift during forward motion in consequence of that aerofoil shape.
5. An air-ship as claimed in any preceding claim, wherein the hulls are wider than they are high.
6. An air-ship as claimed in any preceding claim wherein ventrally as compared to dorsally the hulls are substantially flatter.
7. An air-ship as claimed in any preceding claim, wherein each hull is provided with an upwardly extending generally vertical stabilizer fin adjacent a rear end thereof.

- 14 -

8. An air-ship as claimed in claim 7, wherein said generally vertical stabilizer fin or part thereof is variable in attitude.
9. An air-ship as claimed in any preceding claim, wherein each hull is provided with a laterally extending generally horizontal stabilizer fin adjacent a rear end thereof.
10. An air-ship as claimed in claim 9, wherein said generally horizontal stabilizer fin or part thereof is variable in attitude.
11. An air-ship as claimed in any preceding claim, wherein each hull is provided with a laterally extending generally horizontal stabilizer fin adjacent a forward end thereof.
12. An air-ship as claimed in claim 11, wherein said generally horizontal stabilizer fin adjacent a forward end is variable in attitude.
13. An air-ship as claimed in any preceding claim, wherein the gondola is provided with landing wheels.
14. An air-ship as claimed in any preceding claim, wherein each hull comprises an outer covering enclosing a number of gas containing cells.
15. An air-ship as claimed in claim 14, wherein the covering additionally encloses a number of normally empty cells into which gas may be passed from said gas containing cells to thereby relieve pressure in said gas containing cells.



- 15 -

16. An air-ship as claimed in claim 5, and including pressure responsive valve means adapted to open under a predetermined pressure to allow gas to pass from said gas containing cells to said normally empty cells.

17. An air-ship as claimed in claim 15 or claim 16 and including pump means for pumping gas from said normally empty cells to said gas containing cells.

18. An air-ship as claimed in any preceding claim, and including a framework comprising circumferential bands extending around the hulls, spacer members extending between said bands and spacing the hulls apart and suspension members extending from one of the spacer members and said bands and suspending the gondola.

19. An air-ship as claimed in claim 18, wherein the framework additionally comprises a generally centrally extending keel within each hull and connector members extending from said keel to said bands.

20. An air-ship as claimed in claim 19, and including a plurality of generally radially extending members extending from said keel and supporting longitudinally extending stringer members.

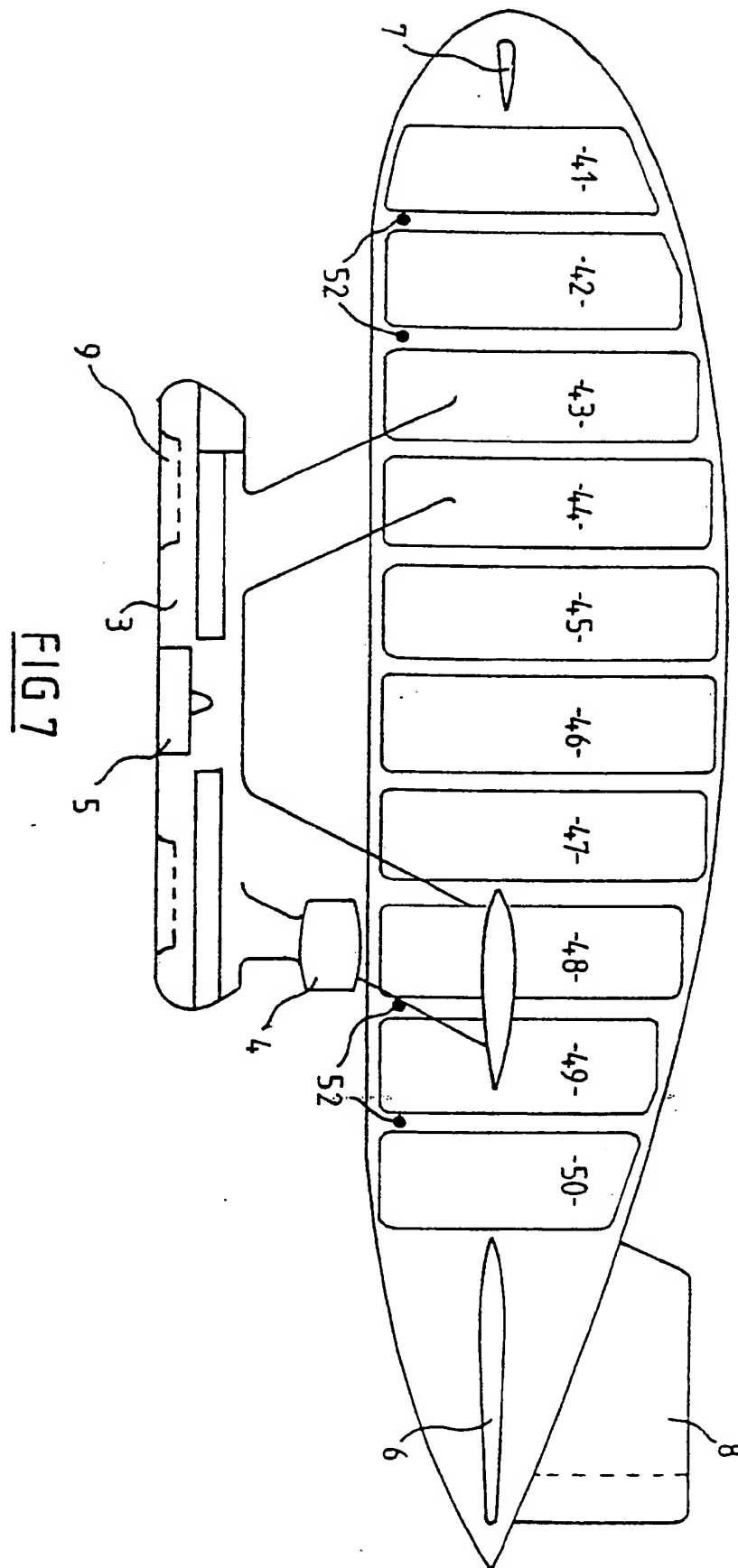
21. An air-ship as claimed in claim 18, wherein the framework additionally comprises a plurality of generally radially extending members supporting longitudinally extending stringer members.

22. An air-ship as claimed in claim 21, wherein the radially extending members support circumferential members.

- 16 -

23. An air-ship substantially as hereinbefore described with reference to any one of the accompanying drawings.

24. The steps or features disclosed herein or any combination thereof.



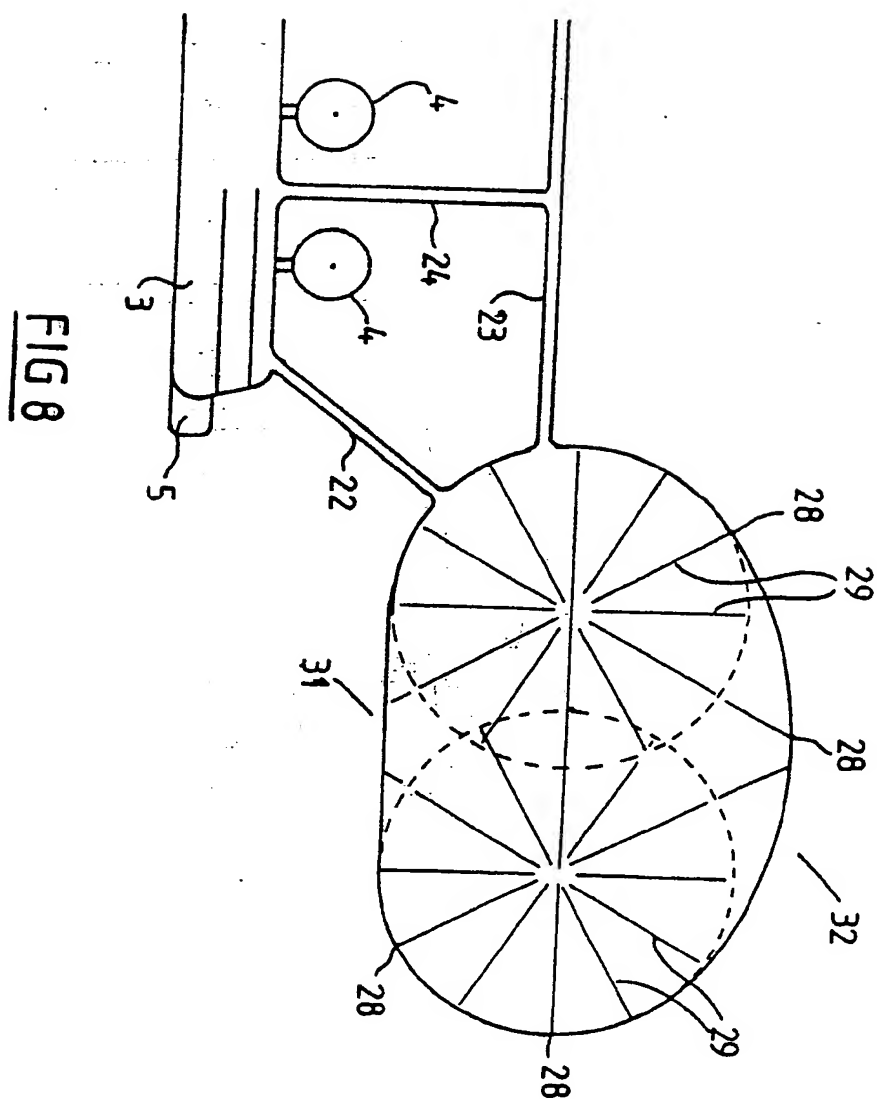
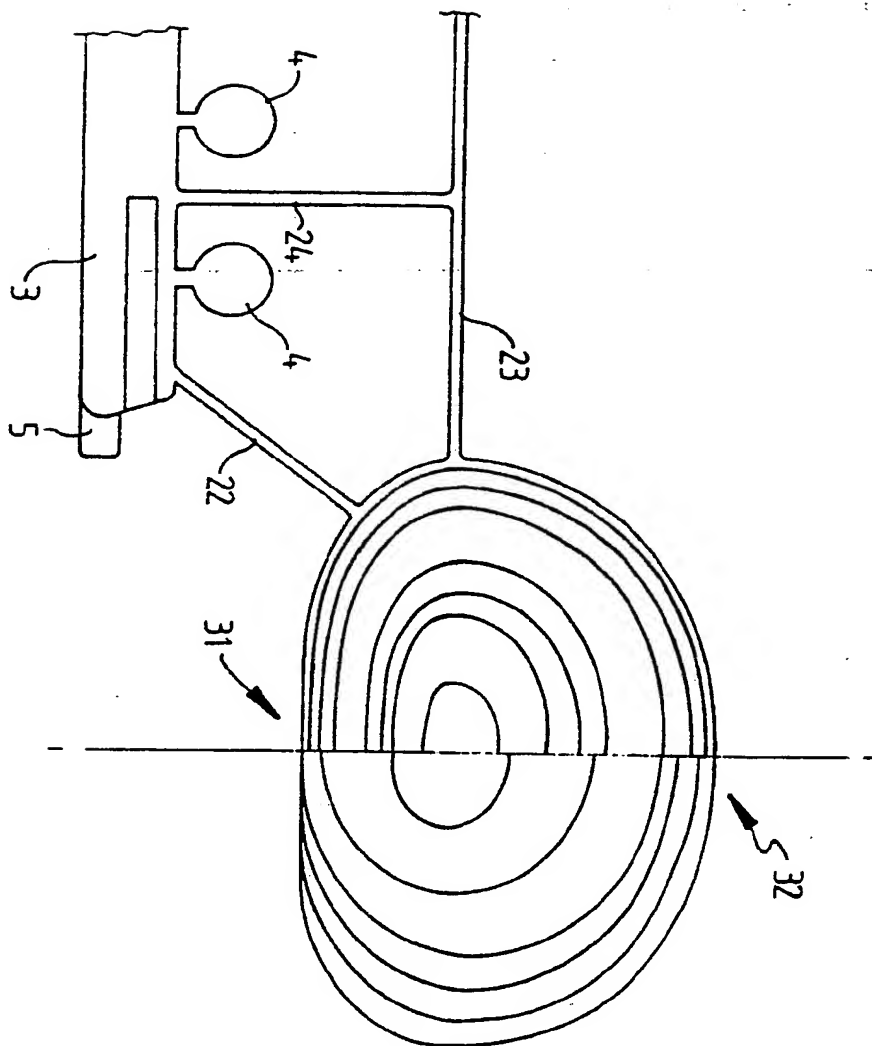
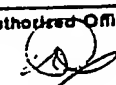


FIG 9



## INTERNATIONAL SEARCH REPORT

International Application No PCT/AU 88/00440

<b>I. CLASSIFICATION OF SUBJECT MATTER</b> (If several classification symbols apply, indicate all) <sup>6</sup> According to International Patent Classification (IPC) or to both National Classification and IPC Int. Cl. <sup>4</sup> B64B 1/06		
<b>II. FIELDS SEARCHED</b> Minimum Documentation Searched <sup>7</sup>		
Classification System	Classification Symbols	
IPC	B64B 1/06, 1/08	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched <sup>8</sup>		
AU: IPC as above GB: Abridgments of Specifications Class 4 1855-1908, 1909-1915		
<b>III. DOCUMENTS CONSIDERED TO BE RELEVANT <sup>9</sup></b>		
Category <sup>10</sup>	Citation of Document, <sup>11</sup> with indication, where appropriate, of the relevant passages <sup>12</sup>	Relevant to Claim No. <sup>13</sup>
X,Y	AU,B, 485070 (54460/73) (MALVESTUTO) 17 October 1974 (17.10.74)	(1-23)
X,Y	US,A, 1808132 (DURING) 2 June 1931 (02.06.31)	(1-23)
X,Y	US,A, 1657955 (BYLEK) 31 January 1928 (31.01.28)	(1-23)
X,Y	US,A, 1343428 (BERRY) 15 June 1920 (15.06.20)	(1-23)
X,Y	FR,A, 538937 (BEYNET) 17 June 1922 (17.06.22)	(1-23)
X,Y	FR,A, 535810 (ENLIND) 21 April 1922 (21.04.22)	(1-23)
X,Y	GB,A, 5829/1912 (SURVILLE) 8 March 1912 (08.03.12)	(1-23)
X,Y	GB,A, 15675/1909 (TATTERSALL) 6 January 1910 (06.01.10)	(1-23)
X,Y	GB,A, 15542/1909 (BELLAMY) 31 December 1909 (31.12.09)	(1-23)
X,Y	GB,A, 11763/1908 (FAIRWEATHER) 26 November 1908 (26.11.08)	(1-23)
X,Y	GB,A, 22103/1898 (ROZE) 20 October 1898 (20.10.1898)	(1-23)
X,Y	GB,A, 7751/1893 (ROZE) 17 January 1894 (17.01.1894)	(1-23)
Y	GB,A, 1877/1896 (FRASER) 14 March 1896 (14.03.1896)	(14-18)
Y	GB,A, 10062/1904 (GLENDINNING) 2 February 1905 (02.02.05)	(14-17)
<p><sup>14</sup> Special categories of cited documents: <sup>15</sup></p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"G" document member of the same patent family</p>		
<b>IV. CERTIFICATION</b>		
Date of the Actual Completion of the International Search 13 February 1989 (13.02.89)	Date of Mailing of this International Search Report 23 FEBRUARY 1989 (23.02.89)	
International Searching Authority Australian Patent Office	Signature of Authorised Officer  G.M. COX	

Form PCT/ISA/210 (second sheet) (January 1985)

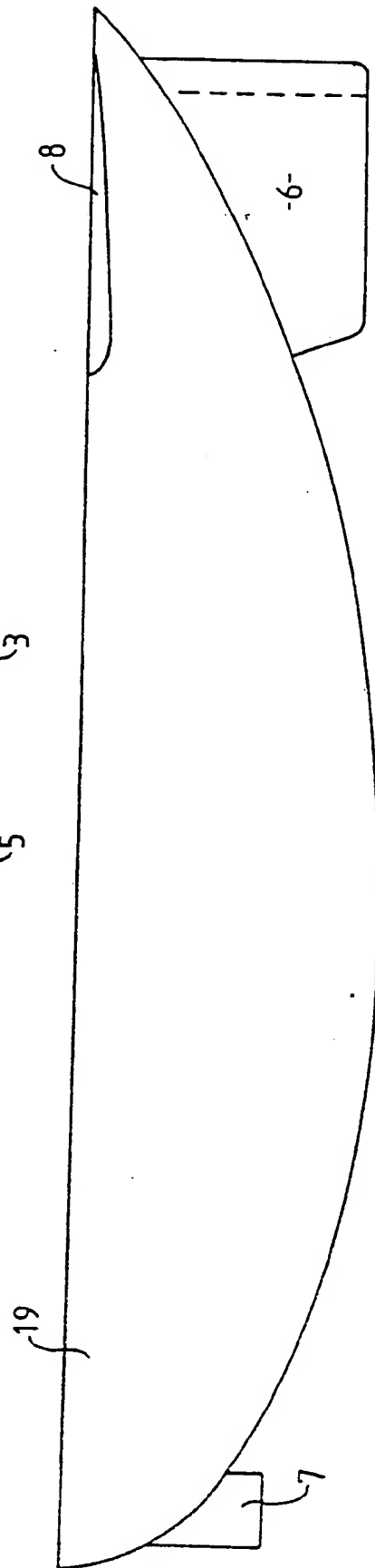
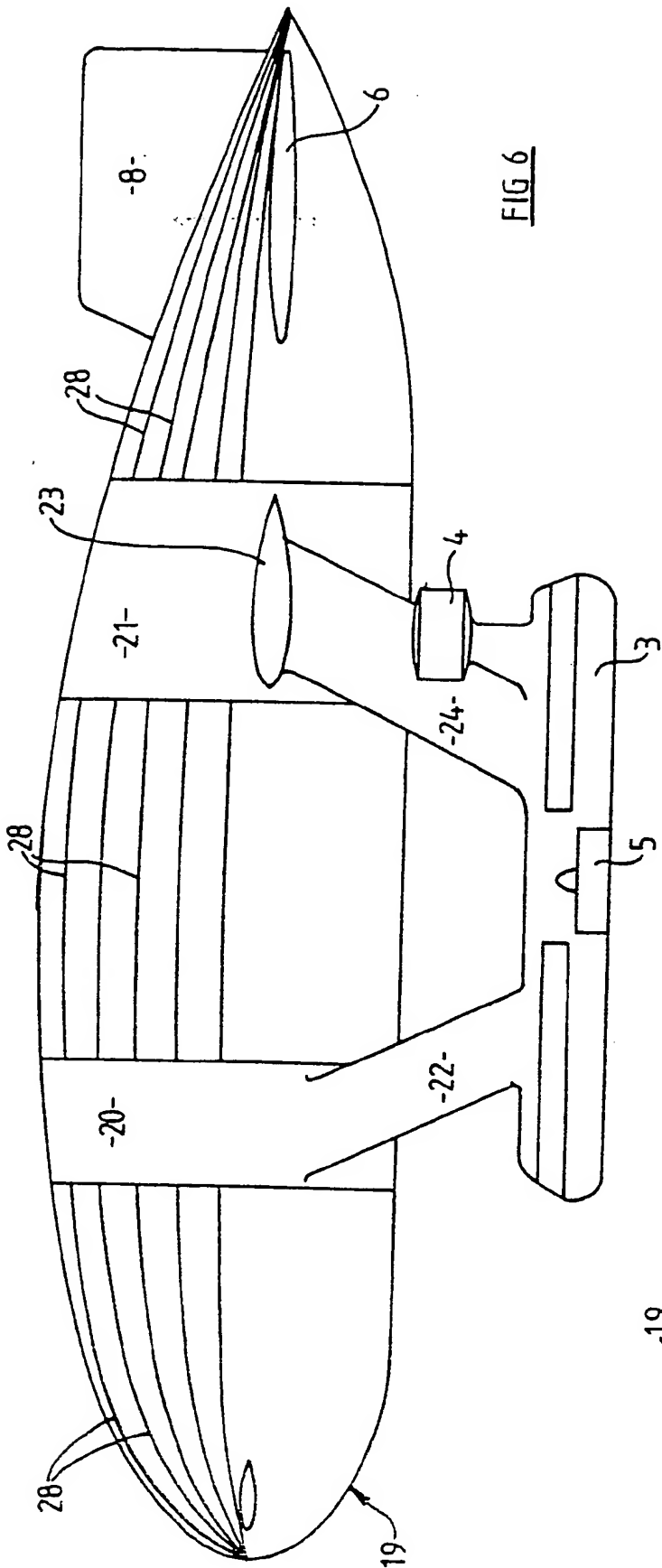


FIG 6



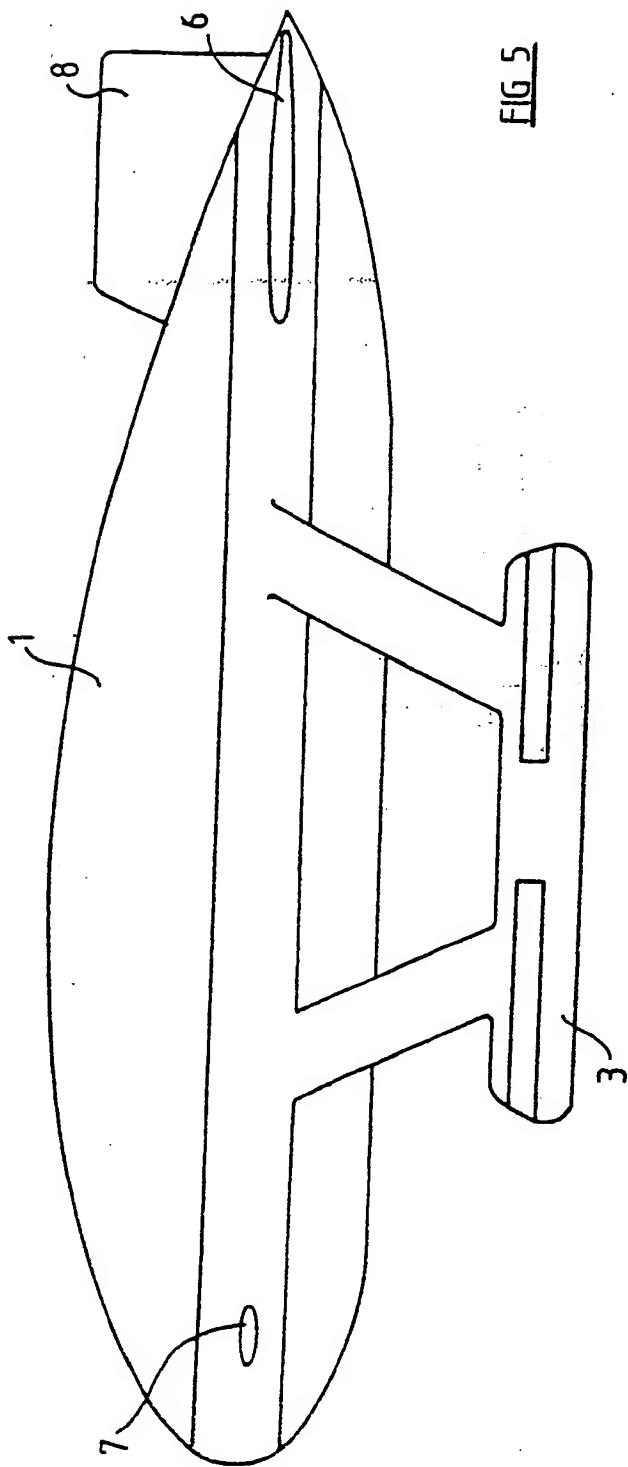
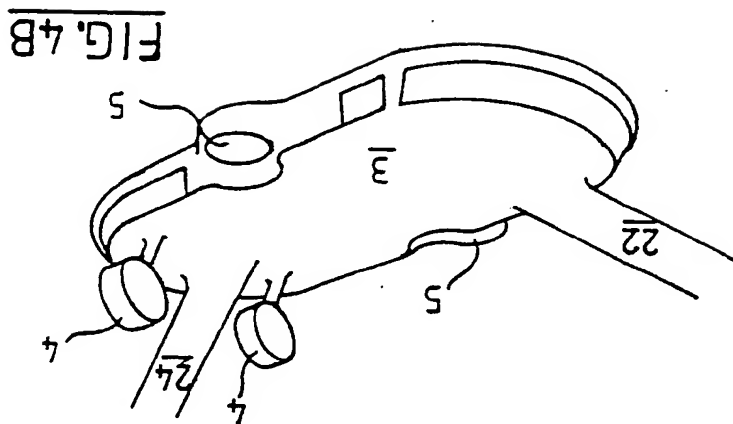
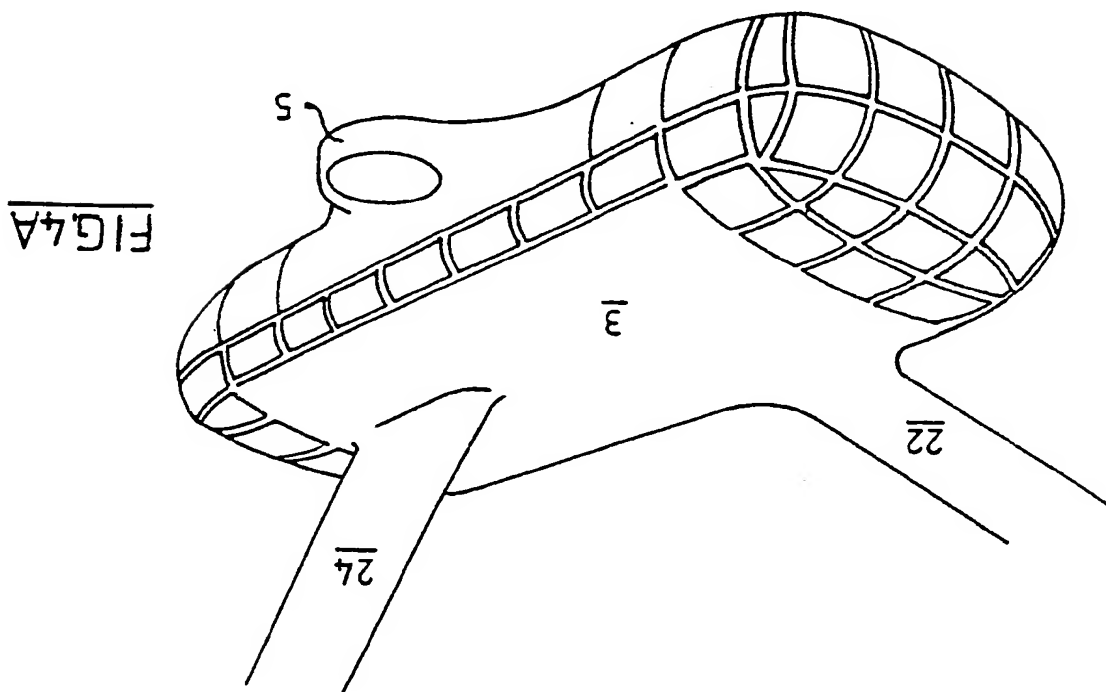


FIG 5





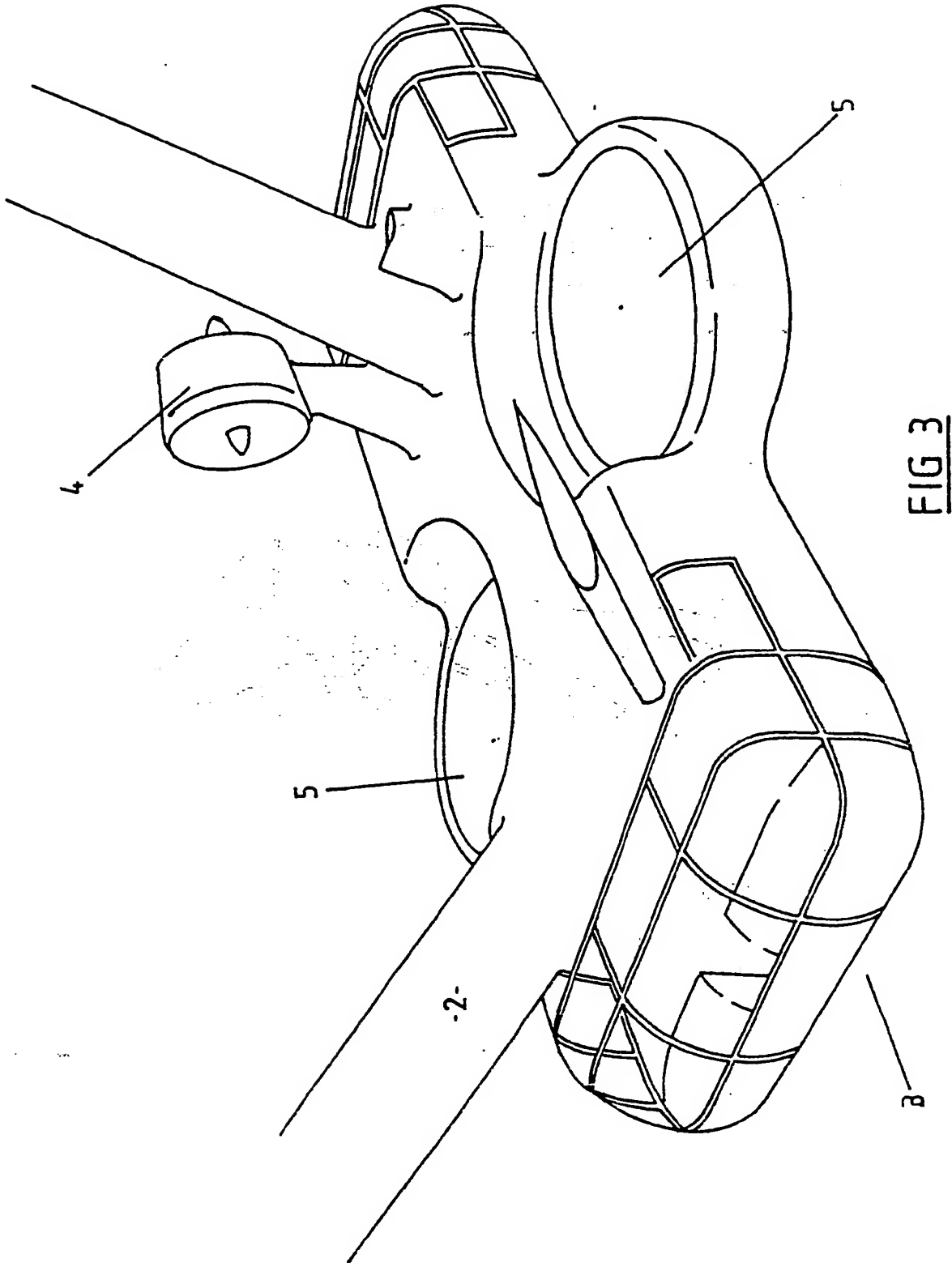


FIG 3

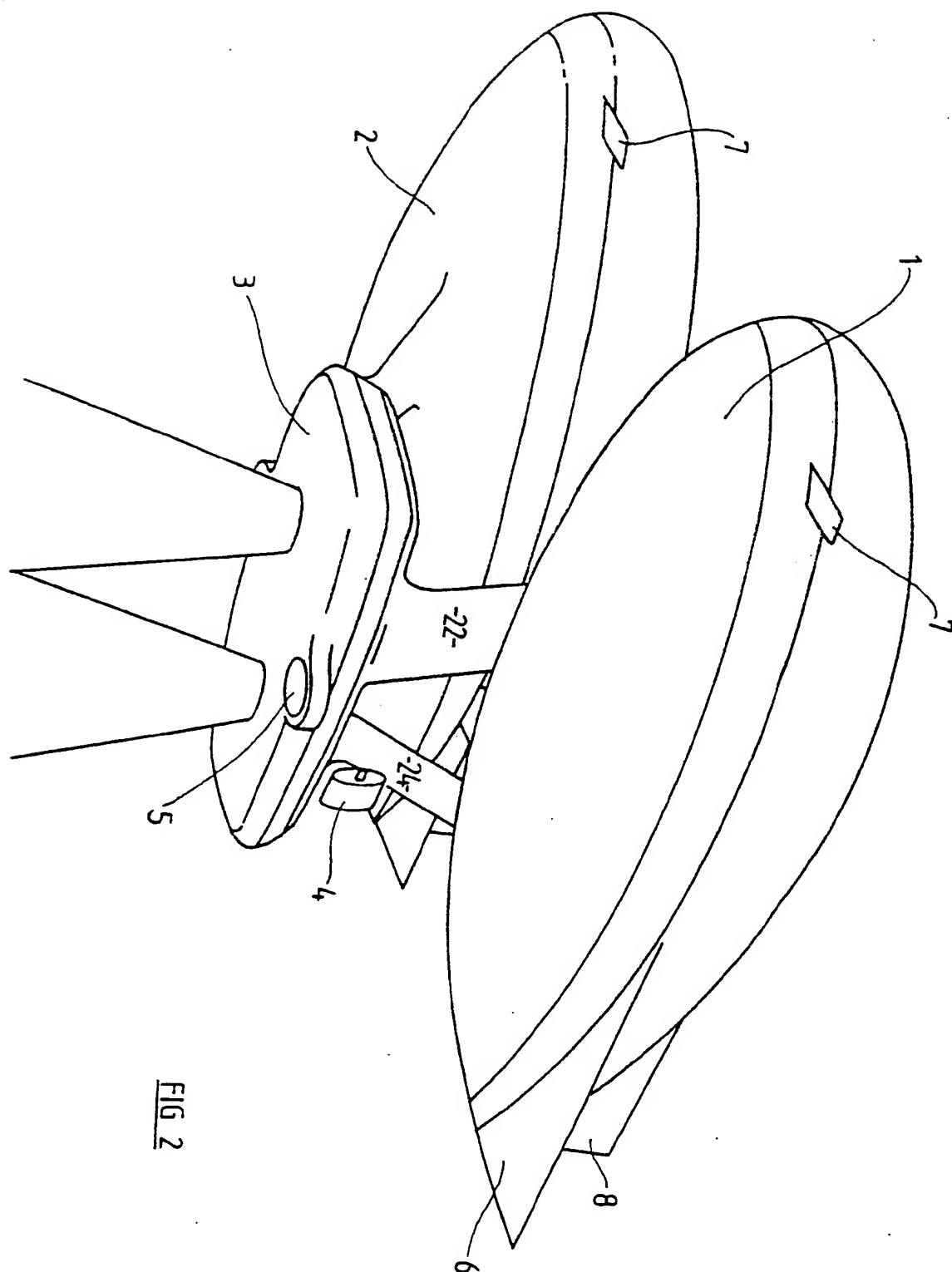
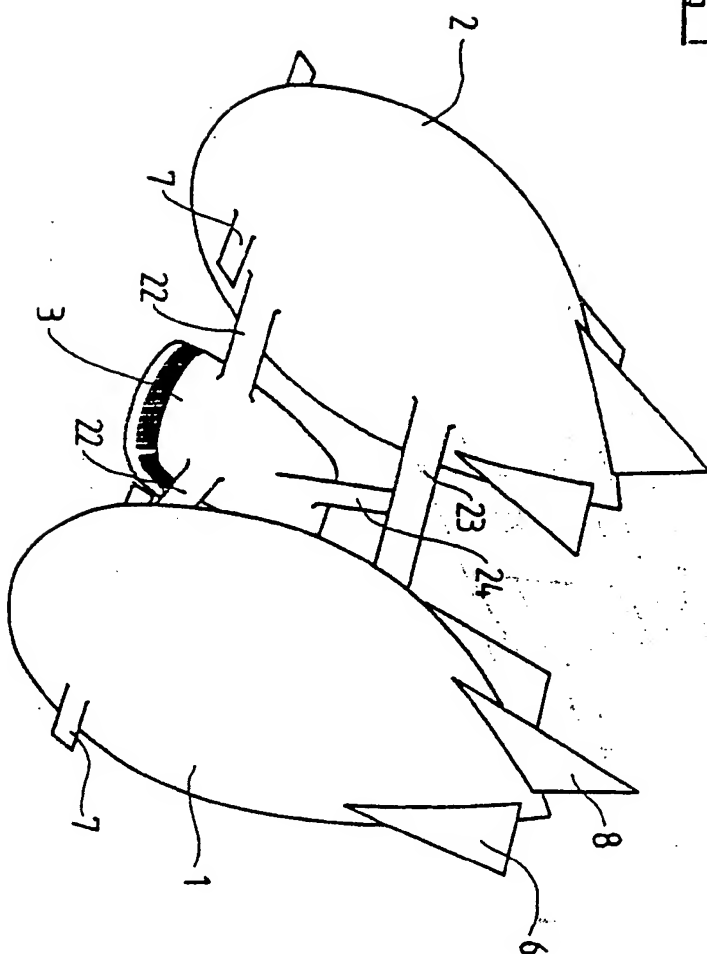


FIG 2

FIG. 1



ANNEX TO THE INTERNATIONAL SEARCH REPORT ON  
INTERNATIONAL APPLICATION NO. PCT/AU AU 88/00440

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

---

Patent Document  
Cited in Search  
Report

Patent Family Members

---

AU 54460/73	AR 204158	CA 989373	CH 576369
	DE 2318022	ES 413589	FR 2180076
	GB 1421013	IL 41967	IT 983825
	JP 49019599	NL 7304785	

---

END OF ANNEX

**THIS PAGE BLANK (USPTO)**

**This Page is Inserted by IFW Indexing and Scanning  
Operations and is not part of the Official Record**

**BEST AVAILABLE IMAGES**

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☐ **BLACK BORDERS**
- ☐ **IMAGE CUT OFF AT TOP, BOTTOM OR SIDES**
- ☐ **FADED TEXT OR DRAWING**
- ☒ **BLURRED OR ILLEGIBLE TEXT OR DRAWING**
- ☐ **SKEWED/SLANTED IMAGES**
- ☐ **COLOR OR BLACK AND WHITE PHOTOGRAPHS**
- ☐ **GRAY SCALE DOCUMENTS**
- ☐ **LINE(S) OR MARK(S) ON ORIGINAL DOCUMENT**
- ☐ **REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY**
- ☐ **OTHER:** \_\_\_\_\_

**IMAGES ARE BEST AVAILABLE COPY.**

**As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.**

**THIS PAGE BLANK (USPTO)**